

I CLAIM:

1 1. A photodetector, comprising:

2 a monocrystalline Si well of a first conductivity type, wherein said well has a
3 surface plane, and wherein said well contains at least one trench downwardly extending
4 from said surface plane;

5 an undoped epitaxial layer lining said at least one trench, wherein said undoped
6 epitaxial layer comprises a $\text{Si}_{1-x}\text{Ge}_x$ layer with $0 < x \leq 1$, wherein said $\text{Si}_{1-x}\text{Ge}_x$ layer has a
7 thickness which is below a critical thickness, wherein a cross sectional surface of said
8 undoped epitaxial layer forms a band which is substantially aligned with said surface
9 plane; and

10 a second material of a second conductivity type disposed over said undoped
11 epitaxial layer but not in contact with said band.

1 2. The photodetector of claim 1, wherein said at least one trench has a depth which is
2 larger than said critical thickness.

1 3. The photodetector of claim 1, wherein said at least one trench has a sidewall which is
2 substantially perpendicular to said surface plane.

1 4. The photodetector of claim 1, wherein said second material substantially fills up said at
2 least one trench.

1 5. The photodetector of claim 1, wherein said second material is selected from the group
2 consisting of monocrystalline Si in epitaxial relation with said undoped epitaxial layer,
3 polycrystalline Si, amorphous Si, polycrystalline SiGe, amorphous SiGe, polycrystalline
4 Ge, amorphous Ge, and their combinations thereof.

1 6. The photodetector of claim 1, wherein said $\text{Si}_{1-x}\text{Ge}_x$ layer is essentially pure Ge.

1 7. The photodetector of claim 1, wherein said undoped epitaxial layer consists essentially
2 of $\text{Si}_{1-x}\text{Ge}_x$.

1 8. The photodetector of claim 1, wherein said first conductivity is p-type and said second
2 conductivity is n-type.

1 9. The photodetector of claim 1, wherein said first conductivity is n-type and said second
2 conductivity is p-type.

1 10. The photodetector of claim 1, further comprising a first electrical contact to said Si
2 well and a second electrical contact to said second material.

1 11. The photodetector of claim 1, wherein said Si well has a first doping level, and
2 wherein said Si well is in contact with a monocrystalline Si body of said first conductivity
3 type, wherein said Si body has a second doping level, and wherein said first doping level
4 is higher than said second doping level.

1 12. The photodetector of claim 1, wherein said Si well has a first doping level, and
2 wherein said Si well is a monocrystalline Si body.

1 13. The photodetector of claim 1, wherein said Si well is in contact with a
2 monocrystalline Si body of said second conductivity type.

1 14. A method for fabricating a photodetector, comprising the steps of:
2 growing by lateral epitaxy an undoped layer lining a trench, wherein said trench is
3 in a monocrystalline Si well of a first conductivity type, wherein said undoped epitaxial
4 layer comprises a $\text{Si}_{1-x}\text{Ge}_x$ layer with $0 < x \leq 1$, and wherein said $\text{Si}_{1-x}\text{Ge}_x$ layer is selected to
5 have a thickness below a critical thickness; and
6 covering said undoped epitaxial layer with a second material, wherein said second
7 material is of a second conductivity type

1 15. The method of claim 14, further comprising the step of filling said trench with said
2 second material.

- 1 16. The method of claim 14, further comprising the steps of:
2 producing said trench, wherein said trench has a sidewall and a bottom; and
3 doping said sidewall and said bottom with dopants of said first conductivity type.
- 1 17. The method of claim 14, further comprising the step of forming a smooth top surface
2 for said photodetector, wherein said smooth top surface comprises:
3 a surface plane of said Si well;
4 a cross sectional surface band of said undoped epitaxial layer; and
5 a surface area of said second material.
- 1 18. The method of claim 14, further comprising the step of selecting said $\text{Si}_{1-x}\text{Ge}_x$ layer to
2 be essentially pure Ge.
- 1 19. The method of claim 14, further comprising the step of reverse biasing said Si well
2 with respect to said second material.
- 1 20. The method of claim 14, further comprising the step of selecting said first
2 conductivity as p-type and said second conductivity as n-type.
- 1 21. The method of claim 14, further comprising the step of selecting said first
2 conductivity as n-type and said second conductivity as p-type.

1 22. The method of claim 14, further comprising the step of selecting said second material
2 from the group consisting of monocrystalline Si in epitaxial relation with said undoped
3 epitaxial layer, polycrystalline Si, amorphous Si, polycrystalline SiGe, amorphous SiGe,
4 polycrystalline Ge, amorphous Ge, and their combinations thereof.

1 23. The method of claim 14, further comprising the step of reverse biasing said Si well
2 with respect to a monocrystalline Si body which contacts said Si well, wherein said Si
3 body is selected to have said second conductivity type.